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ABSTRACT

A longitudinal study followed the language acquisition of three deaf infants. Analysis of videotapes recorded in the child's home during informal play was performed in terms of communicative gestures. Results revealed that Ss used a very limited number of hand configurations, locations for signs, and hand and arm movements. Analysis of the gestures showed that there was a great deal of similarity in the components used by the three Ss. Ss presented consistent patterns in their gestures. Although the single gesture utterance was the most common communicative form, all Ss did combine gestures to form two-gesture utterances. Speech was infrequently used, and all Ss had larger gestural than spoken lexicons at 30 months. It was possible for elements in two gesture utterances and word/gesture combinations to be produced simultaneously. The content of the utterances indicated that they were able to express the same semantic relationships as hearing children at a similar stage of language development. (CL)

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A LONGITUDINAL STUDY OF THE LANGUAGE DEVELOPMENT OF THREE DEAF CHILDREN OF HEARING PARENTS.

by

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INTRODUCTION

Recent research has suggested that language development should be viewed in the context of the development of communication systems (Bates, 1976; Halliday, 1975). Thus the use of symbols and syntax in a fully developed language can be seen as the end-point of a developmental process having its roots in the non-verbal communication systems used in infancy. It has also been suggested that language development and cognitive development are closely allied (Edwards, 1973).

The deaf child of hearing parents is presented with, at best, an incomplete spoken language model. Consequently these children, of necessity, prolong the period of non-verbal communication (Feldman, Goldin-Meadow & Gleitman, 1978). However, as there is no evidence that deaf children are delayed in cognitive development (Furth, 1971; Vernon, 1968) it is to be assumed that they will wish to communicate much the same sorts of things as hearing/speaking children. It is therefore suggested that they adapt and enlarge the non-verbal systems developed in infancy to enable the expression of complex semantic relationships (Tervoort & Verbeck, 1967).

In this study communication systems developed by deaf children of hearing parents were analysed in terms of both the structure of the systems and the semantic relationships which could be expressed.

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METHOD

Subjects

The subjects (2 boys, Grant and Steven, and 1 girl, Annette) were the youngest children attending an oral pre-school for deaf children at the commencement of the study, who had:-

1) A congenital severe or profound hearing loss
2) No other identifiable handicaps
3)* No manual methods of communication available to them

(*Grant did not fully satisfy this criterion as shortly after the commencement of the study his parents started to use Cued Speech. However, as this was not used systematically and as Grant did not appear to attend to it, and never used it, it was decided to retain him in the study.)

At the beginning of the study Grant was 13 months old, Steven was 18 months old, and Annette was 21 months old.

All of the children had had their hearing loss diagnosed no more than three months prior to the time of inclusion in the study.

Grant had a hearing twin sister and an older brother and sister. Steven and Annette were both the only child in their respective families.

All of the children came from comfortable middle-class homes, and none of the mothers were employed outside of the home.

Data Collection

Half-hourly videotapes were made by the experimenter in each dhild's home at monthly intervals, Grant and Steven being followed until they were 30 months old and Annette until she was 38 months old. The parents were informed that the purpose of the investigation was to study the language development of deaf children and were asked to follow a normal routine during the filming sessions. The content of the videotapes varied, but mainly involved the mother and child in informal play activities. Occasionally other members of the family were also present.

Analysis of Videotapes

The analysis of the videotapes presented many methodological problems. First, communicative gestures had to be separated from all the wriggling and ear scratching, and attempts at speech had to be separated from all other vocalizations.

The criteria for accepting spoken words were:-

a) They were uttered with the intention of communicating

b) They approximated English words

The criteria for accepting gestures were:-

a) That they were used with the intention of communicating, therefore, excluding informative and interactive behaviours.

b) That they were symbolic, thus eliminating direct actions on people or objects.

c) That they were made primarily with the arms and hands, although head shakes and nods were also accepted. (Non-verbal behaviours such as posture, facial expression and gaze were excluded, although these para-linguistic behaviours frequently were used as indicators of intent to communicate and also as clues to the meaning of gestures.)

The gestures were described in terms of the notational system proposed by Stokoe (1961) to describe the signs of American Sign Language. In this system the sign (or gesture) is defined in terms of the hand configurations (dez), the place where the sign is made (tab), and the movements of the hands in executing the sign (sig). Stokoe referred to these components of signs as the cheremes and regarded them as equivalent to the phonemes of spoken language, although they are obviously produced simultaneously rather than consecutively.

Reliability of Transcriptions

In the literature on the acquisition of spoken language by hearing children, there is a lamentable lack of reliability studies on date transcriptions. Thus detailed analyses and sophisticated theories frequently rest on one person's interpretation of the child's spoken utterances (e.g., Halliday, 1975; Bloom, 1970; Greenfield & Smith, 1976). There are good reasons for this. It is essential that the second

transcriber be as familiar with the child, with the home environment and with the type of data being analysed as the experimenter if high levels of agreement are to be reached. Such personnel are not readily available, therefore extensive training programmes are likely to be required. Reliability studies are therefore time consuming and expensive to conduct. However, as the present data are particularly vulnerable to the criticism of experimenter bias and reading too much into vague movements, it was deemed essential to demonstrate that acceptable degrees of reliability could be obtained for the transcription of the videotapes. Extensive reliability studies were therefore undertaken. The percentage of communicative units identified by both transcribers ranged from 71% to 92% depending upon the complexity of the tape and the method of transcription. There were felt to be acceptable levels of agreement.

I. RESULTS Cherology - Handshape, location and movement of the hand and arms.

Schlesinger & Meadow (1972), McIntire (1977), and Prinz & Prinz (1979) reported that children who are exposed to sign language from birth begin to use signs at an earlier age than hearing children begin to use spoken words.

This is surprising, as data on neurological development suggests that hand function is fairly premature in the first year and that the child does not have good control over individual finger movements. This suggests that any signs which are produced are likely to show considerable distortion. Schlesinger & Meadow mentioned that the children in their study used "baby signs" and Prinz & Prinz gave a few examples of handshape distortions.

In the same way that hearing children produce certain sounds before others, it might be expected that deaf children would produce some of the cheremes of Sign Language before others. Boyes (1973; reported in Siple, 1978) applied the concept of markedness developed by Jakobsen (1968) to predict the order of acquisition of the handshapes of American Sign Language (ASL) by children.

Boyes grouped ASL handshapes into the following four categories, ordered in terms of difficulty and complexity, and predicted that the order of acquisition would follow this pattern. (The letters and numbers represent the positions adopted by the fingers in representing the American one-handed fingerspelled alphabet.)

1.	A	S	L	(baby)	0	5	C	G
2.			B		F		O	
3.	I	D	Y	P	3	V	H	W
4.		8	7		X	R	T	

('Baby O' handshaped is formed by opposition of the thumb and index finger, i.e., the configuration used for a pincer grip).

McIntire (1977) analysed the data obtained from four videotapes of a deaf child acquiring ASL between the age of thirteen and twenty-one months in terms of the substitution errors in the handshape component of the signs produced by the child. She found that a high percentage of the handshapes used by the child were from Boyes' Group 1 and that substitution errors were always in the direction of using a hand configuration from an earlier group.

Analyses of the gestures used by the three children in the present study showed that they all used a very limited number of different handshapes, locations for signs and hand and arm movements. There was a great deal of similarity in the components used by the three children.

The B and 5 - handshapes were not distinguishable before the age of 30 months, the handshape produced rather being a relaxed flat hand with the fingers slightly apart. This was called 'Baby B' handshape. This handshape was used on the first videotape of each subject and was by far the most frequently used handshape on all tapes. The next most frequently used handshape was the G-hand (pointing hand). A, O, and C handshapes were occasionally used. All of these handshapes were present before two years of age and no new handshapes were used up to thirty months of age. These findings are consistent with those of Boyes and McIntire.

Most of the gestures used by Grant, Steven and Annette were made in the space immediately in front of their bodies. They often made contact with objects but much less frequently made contact with their own body when gesturing.

The range of hand and arm movements used by the three children was also limited. Large up/down or in/out sweeps of the arm were the most frequently used movements, followed by wrist movements and wriggling of the fingers. No gestures involving the interaction of the two hands were observed. This is consistent with the finding of Berges and Lezine (1965), and Connolly and Elliott (1972).

Knowledge of the types of handshapes and arm and wrist movements which children are capable of making, and which they spontaneously produce, permits predictions to be made about the types of errors which young children are likely to make when using Sign Language. Armed with this information teachers and parents should be able to improve their ability to understand the deaf child and consequently to respond more appropriately to his attempts at communication.

II. Frequency of Production of Gestures and Speech

All three children in the present study communicated primarily by means of gestures (Figure 1). As would be expected there was some variability in the frequency of gesturing from tape to tape. However, subjects tended to present consistent patterns.

Steven and Annette characteristically made frequent attempts to communicate by means of gesture, in contrast to Grant's rare gestural communication. A dramatic increase in the frequency of gesture production occurred for Annette at 28 months of age, and was maintained. This can be compared with the sudden increases in speech production observed in hearing children learning to talk.

Few spoken words were produced by the children. Annette produced significantly more speech than the others. However, in contrast to her high rate of gesturing, her speech production was sparce. An increase in her speech production was observed at 32 months and this was also maintained (Figure 2).

It is interesting to speculate whether Grant's apparent lack of interest in communicating was related to his twinship (Day, 1932; and Mittler, 1970 reported delayed language development in twins. His hearing loss was diagnosed earlier than either of the other two children and he had Cued Speech available to him. It might therefore have been expected that he would be the most advanced in language development.

III. Utterance Length

Gestural utterances. It is first essential to define the features which determine the beginning and end of an utterance, i.e., the gestural juncture cues. The beginning of an utterance is usually identified by the hands moving from rest and starting to gesture. Pausing, returning the hands to a resting position, or holding a gesture for longer than usual, have all been described as end juncture in American Sign Language (Stokoe, 1972; Covington, 1973). There were also found to be the major cues for juncture in these children's gestural systems. Direct imitation and interruptions were also taken as end markers.

Gestural strings consisting of the repetition of a single gesture were counted as single gesture utterances, and repetitions of two gestures were counted as a single two-gesture utterance.

In adult sign language, repetition may be used to indicate pluralization, an ongoing activity, or emphasis (Cohen, Namir & Schlesinger, 1977). There was little evidence that it fulfilled any of these functions in these children's communication systems, with the possible exception of emphasis. Most frequently repetition seemed to be used when the mother did not initially respond.

In most cases there was little doubt about utterance boundaries, and inter-rater reliabilies on utterance length consistently reached over 90%.

For all of the children, the single gesture utterance was the most common communicative form. However, they all combined gestures to form two-gesture utterances (Table 1).

The frequency of two-gesture utterances increased as the children got older and Annette and Steven occasionally produced three- and four-gesture utterances. However, the steady rise in mean length of utterance observed in Brown's (1973) hearing subjects was not observed, possibly due to the fact that the gestural systems did not contain any bound morphemes (Figure 3).

Spoken utterances. Speech was infrequently used by all of the children and only three instances of two-word utterances were recorded (see Table 2). Although words were rarely combined, word/gesture combinations did occur and were apparently becoming Annette's chosen method of communication. The word and gesture in these combinations frequently carried the same meaning, e.g., "no" and a headshake, "allgone" and an 'allgone' gesture, so that the two elements reinforced each other. Words and gestures were, however, also combined to make more complex utterances, e.g., Annette, at 27 months, whilst playing at feeding her dolls pointed to a cup, simultaneously said "baby", then gave the doll a drink from the cup. Utterances in which the gesture and word carried different meanings were more frequent on the later tapes. In over 90% of the word/gesture combinations, the two elements occurred simultaneously. This is in marked contrast to spoken language in which the elements, i.e., words must, of necessity, be produced sequentially.

IV. Establishment of a Lexicon

It was crucial to demonstrate that each child established a lexicon, otherwise it could be argued that they simply generated gestures or pantomime to express an idea at a particular time but did not use gestures consistently or systematically to establish a communication system.

In order to be included in the child's lexicon both spoken words and gestures had to be:-

1. used consistently, i.e., they had to appear on at least two tapes. Thus pantomime generated to convey a particular idea was excluded.

2. used spontaneously, i.e., direct imitations of the mother's speech or gestures were excluded. (In practice, it was found that the mothers more frequently imitated the child's gestures than vice versa).

These stringent criteria may have led to an under-estimation of the child's lexicon. However, it is unlikely that any items which are not part of the lexicon have been included.

Pointing was by far the most frequently used gesture for all three children. If this was glossed separately for each referent, it unrealistically inflated the child's lexicon.

On the other hand, if pointing was excluded, it denied a great deal of the communicative behaviour of the child. It was ultimately decided to include pointing in the lexicon under three readings:

(i) Pointing to an object which could be translated by 'this' or 'that'.
(ii) Pointing to a person which could be translated by a pronoun.
(iii) Pointing to a location which could be translated as 'there'.

The remaining gestures were glossed on the basis of extralinguistic contextual clues and on clues from the iconic nature of the gestures, e.g., "car". There are problems with this, however, as the gesture glossed "car" could equally well be glossed "drive" and "food" could equally well be "eat". Therefore, great care had to be taken in glossing items and the glosses had to be checked for appropriateness each time the gesture occurred.

Although there was little evidence of direct imitation on the videotapes, almost all of the gestures used were common ones which had apparently been gleaned from the hearing community, e.g., "give me", "where", "here", "sleep", "come", "stop", "all gone". There was, therefore, considerable commonality in the gestures used by the three children as they came from very similar cultural backgrounds. Both Steven and Annette used pantomime to communicate, but there were few

examples of invented gestures forming stable elements in the children's lexicons (Table 3).

All of the children had larger gestural than spoken lexicons at 30 months. In both modalities however, their lexicons were extremely meagre, and unlike hearing children in whom a sudden burgeoning of vocabulary is observed, they appeared to add to their lexicons slowly and laboriously.

Although Annette showed dramatic increased in the frequency of production of gestures and spoken words after 30 months of age there was no concomitant dramatic increase in her gestural or spoken lexicons (Table 4).

It would, therefore, seem that when deaf children are not presented with a systematic language model in either the auditory/vocal or the visual/motor channel, they attempt to develop communication systems based on whatever gestures and sounds are available to them. Thus the child's communication system is based on an incomplete and inconsistently used gestural language model and a few arduously learnt spoken words.

V. Structure of Utterances

All utterances containing two communicative units were analysed in terms of the positions of the elements in the utterance. The two elements occurred simultaneously in over 90% of word/gesture combinations and occasionally also in two-gesture combinations. In most gestural utterances however, the elements appeared sequentially.

An analysis of these sequentially organized utterances showed that for Grant and Steven no gestures occupied privileged positions of occurrence. For Annette, however, up to 28 months "pointing" when it occurred, always occupied the first position in the utterance (except of course, when both elements in the utterance were pointing, e.g., pointing - object A - pointing - object B) and "give" was always a second position gesture.

On later tapes when Annette was producing longer utterances these gestures ceased to occupy their privileged positions.

Neither "pointing" nor "give" could, however, be regarded as pivots as they could be combined with each other in an utterance and pointing

could be combined with pointing in an utterance. Gesture order in two-gesture utterances could, therefore, be regarded as generally more flexible than word order in spoken utterances.

VI. Semantic Functions

Considering the short surface structure and flexible gesture order one might expect that the children's utterances would be highly ambiguous. In practice this was not the case as contextual and paralinguistic cues disambiguated most messages and the children were able to convey quite complex ideas. E.g., "give" was a common gesture used by all of the children. This requires an actor, a patient, and a recipient, any or all of which could be deleted from the gestural utterance. The actor was usually nominated by means of glancing, the patient by the direction of the hand, and in all cases the recipient was the child.

The recent trend in the literature to the analyses of prelinguistic vocalization and one-word utterances has provided precedents for combining utterance and context for the analysis of the child's early utterances. This rich interpretation permits the analysis of the underlying semantic functions which the child is able to express.

An analysis of the subjects' utterances based on the system proposed by Greenfield and Smith (1976) was carried out and examples from Annette's and Steven's utterances were found to fill all of the semantic functions. No examples could be found for two semantic functions in Grant's utterances (Table 5).

The age at which each semantic function was first recorded for each subject together with the data from one of Greenfield & Smith's subjects (Nicky) is presented in Table 5. Unfortunately as Steven and Annette were older than Greenfield & Smith's subjects at the beginning of the study, the developmental patterns are not obvious, as most of the semantic functions were already present. Some developmental trends can be observed for Grant.

In Table 6 examples from Annette's data are presented to illustrate each semantic function.

CONCLUSIONS

Deaf children of hearing parents, who do not have access to an intact language model, satisfy their desire to communicate primarily by the use of gestures which they glean from the hearing community. Their gestural and spoken lexicons are small and the structure of their communication system is very simple.

In the present study the most common utterance was the single gesture utterance, however, gestures were combined with each other and with spoken words to produce longer utterances.

In two gesture utterances and in word/gesture combinations it was possible for the elements to be produced simultaneously. This is in marked contrast to the temporal sequencing of spoken language. In general, the gesture order in utterances was more flexible than the word order of spoken language used by hearing children.

The content of the children's utterances indicated that they were able to express the same semantic relationships as hearing children at a similar stage of language development.

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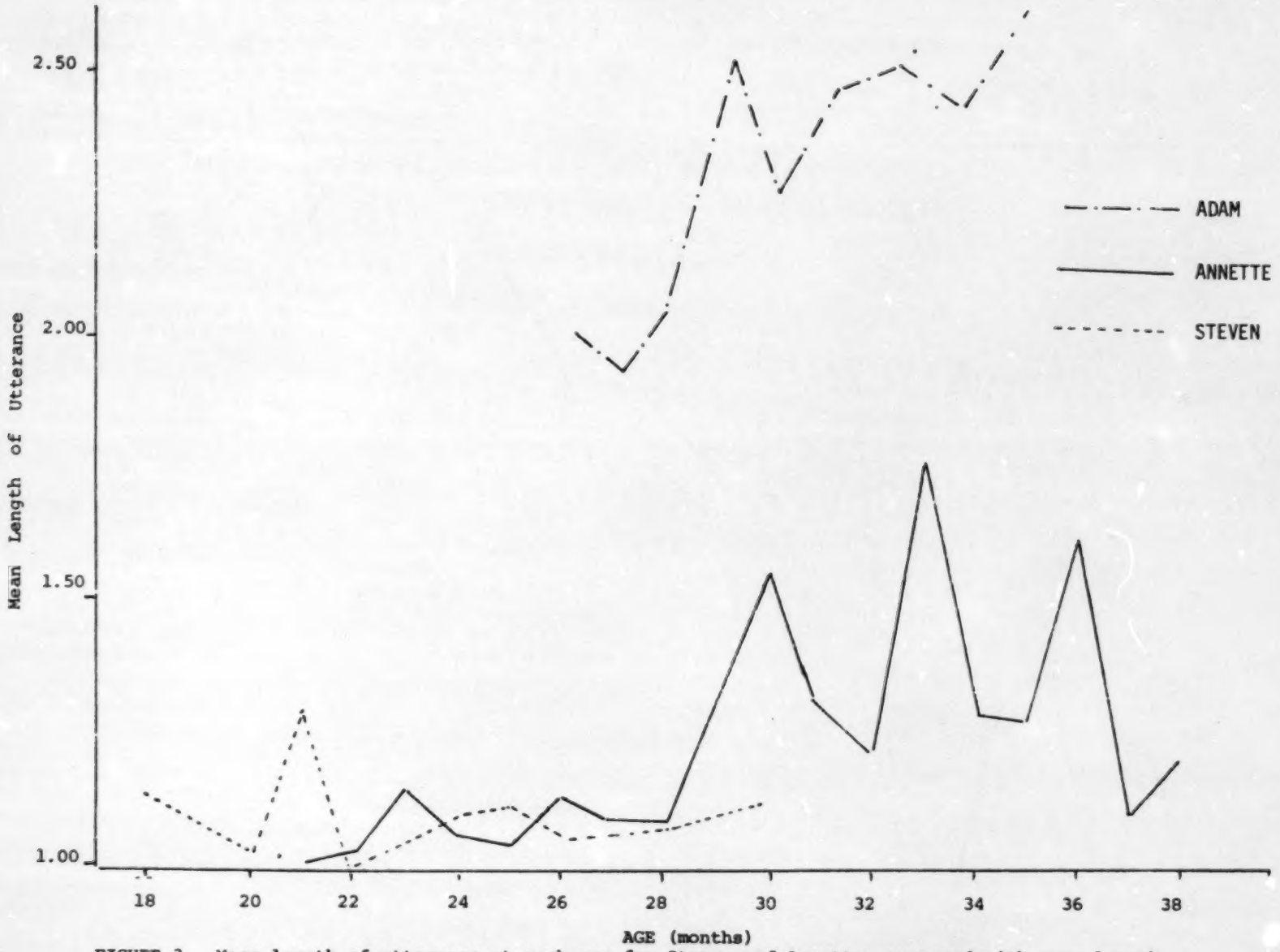

FIGURE 3. Mean length of utterance at each age for Steven and Annette, compared with mean length of utterance for Adam, one of Roger Brown's hearing subjects (Brown 1974)

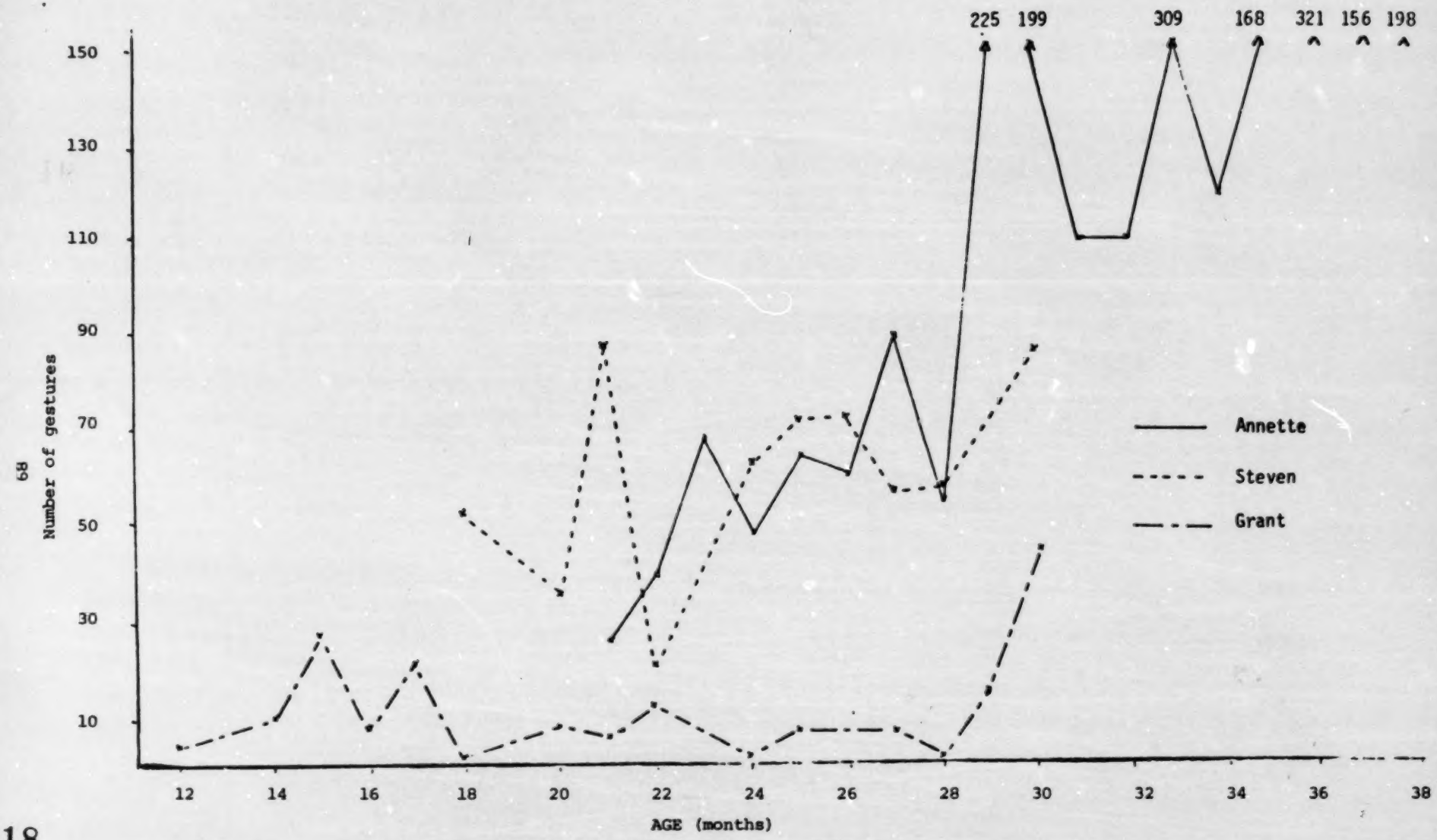

FIGURE 1. Total number of gestures, including imitations and repetitions, on each tape.

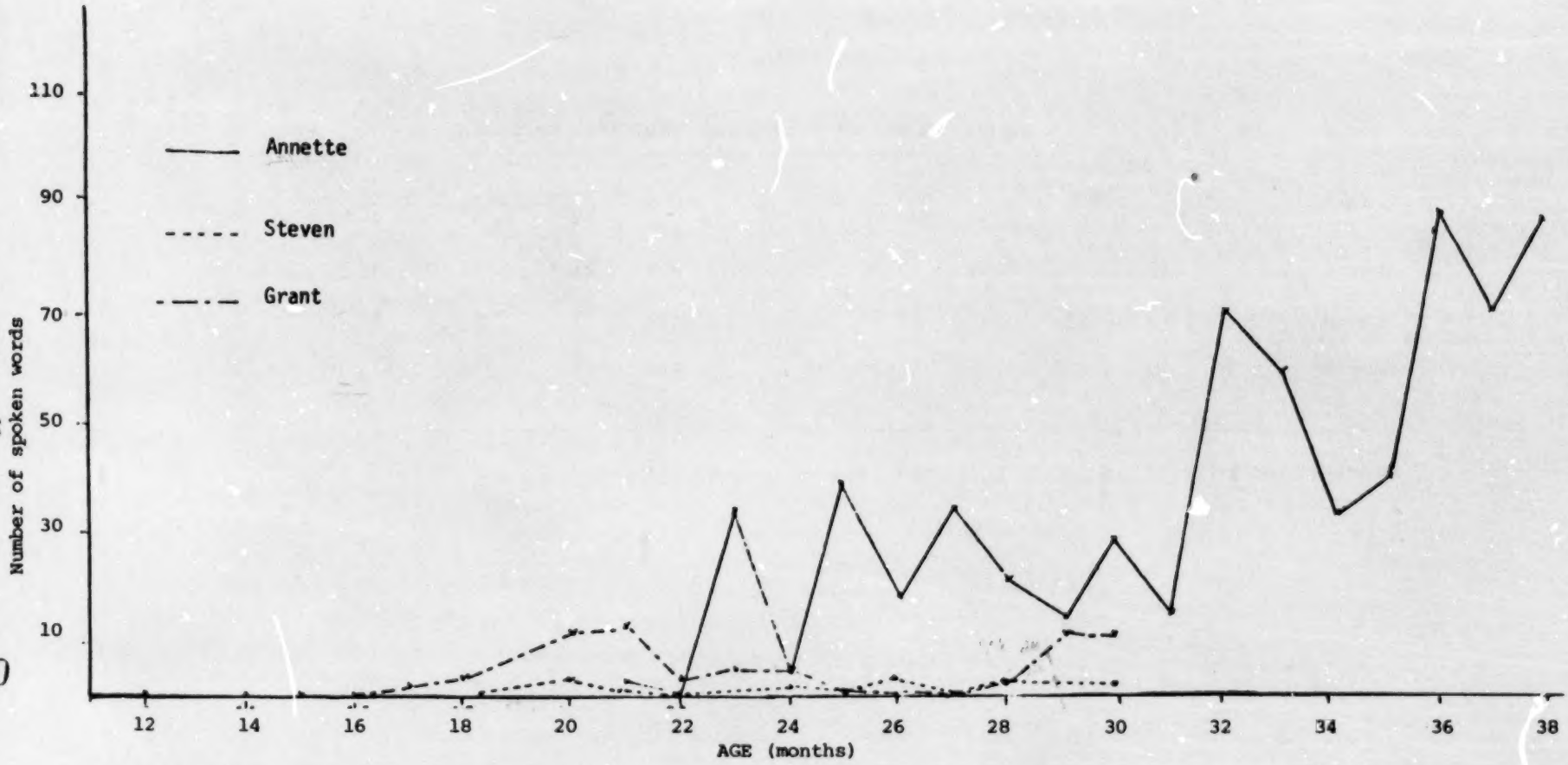

FIGURE 2. Total number of spoken words, including imitations and repetitions, on each tape.

TABLE 1

Number of Gestural Utterances According to Length

Subject	No. of tapes	Age range (months)	No. of gestures/utterances			
			1	2	3	3+
Grant	17	12-30	108	21	-	-
Steven	10	18-30	426	37	5	5
Annette	10	21-30	430	68	11	13
Annette	8	31-38	484	129	28	24

TABLE 2

Number of spoken utterances according to length

Subject	No. of tapes	Age range (months)	No. of gestures/utterances 1	2	1 word +1 gesture	*Complex mixed
Grant	17	12-30	29	-	9	-
Steven	10	18-30	5	-	9	-
Annette	10	21-30	66	1	62	21
Annette	8	31-38	111	2	129	69

*Complex mixed utterances consisted of both gestures and speech and contained more than two elements.

TABLE 3

Gestural and spoken lexicon at 30 months

	Gestural lexicon at 30 months	Spoken lexicon at 30 months
Grant	9 (13)	3 (13)
Steven	22 (41)	2 (12)
Annette	35 (72)	9 (20)

(The figures in brackets indicate the total number of different gestures and words recorded, i.e., including those which occurred on one tape only).

TABLE 4

Gestural and spoken lexicons for Annette at 38 months

	Gestural lexicon at 38 months	Spoken lexicon at 38 months
Annette (18 tapes)	65 (111)	1[illegible] (41)

TABLE 5

Age (months) at first recording of each semantic function

	Grant	Steven	Annette	Nicky
Performative	15	18	21	8
Volitional	12	18	21	11
Agent	16	18	22	13
Action or stage of agent	14	20	23	14
Object	24	18	22	16
Action or stage of object	18	20	21	18
Dative	20	20	23	18
Obj. Assoc. with obj.	22	21	22	18
Animate Assoc. with obj.	-	24	22	18
Location	30	21	22	18
Modification	-	21	27	19

TABLE 6

Examples of each of Greenfield and Smith's semantic functions taken from Annette's data.

Semantic Category	Item	Context
Performative	Bye-bye	A gives a doll to Mo and takes a step back and waves bye-bye.
Volitional	Give	A holds out her hands towards a doll which is out of reach and glances at Mo. (I want the doll.)
Agent	Pointing (person observer)	A lies across mothers knee watching H. filming. Glances at Mo and points to H. (Heather is filming).
Action or State of Agent	"Mistake"	A throws pencil under the side board. Looks at Mo and places her hand over her mouth. (I made a mistake).
Object	Pointing (object ribbon)	A tries to take ribbon off the rabbit. She can't do it so she holds the rabbit towards Mo and points to the ribbon. (Take the ribbon off mum).
Action or State of Object	Hot	A looking at radiator holds up her hand in gesture for HOT and glances at the doll which she is holding. (The radiator is hot).
Dative	Supinated pointing	A places a cup in front of the doll and points to the doll (This is for you).
Object Associated with an object or location	Pointing (Object container or location near)	A studies a container with which she has been playing. She points to its rim and looks around on the floor for the lid. (Where's the things which belongs here?)
Animate being associated with an object or location	Pointing (location) "mork" (work)	A looking at family picture, recognizes her father and points to the front door and says "mork" (work). (Daddy is out at work).
Location	Pointing (Mo's ear)	A drops Mo.'s earring. Mo. picks it up. A points to Mo.'s ear. (The earring goes on your ear).
Modification of an event	"More"	A holds a cup and a jug towards the dolls and says "more" (Would you like more to drink?)